Standard Intrauterine Growth Curve of Thai Neonates Delivered at Rajavithi Hospital

Pure Borisut MD*,
Ekachai Kovavisarach MD*

* Department of Obstetrics & Gynecology, Rajavithi Hospital, College of Medicine Rangsit University, Bangkok, Thailand

Objective: To determine the distribution of Thai neonatal birthweights classified in gestational age and sex to create standard intrauterine growth curves of Thai neonates.

Material and Method: A retrospective study was performed in Thai singleton pregnant women with confirmed gestational age between 24 and 42 weeks (168-294 days), delivered at Rajavithi Hospital. Birthweights were graphed as 5th, 10th, 50th, and 90th percentile, and classified in gestational age as male, female, and both sexes.

Results: In all 7,506 neonates: 3,973 male and 3,533 female, were included during the 4-year study period. The standard intrauterine growth curves at 5th, 10th, 50th, and 90th percentile in male neonates were higher in value but similar in shape than those in female neonates.

Conclusion: Male birthweights were higher but similar in shape compared with those of female in all gestational ages (24-42 weeks).

Keywords: Thai neonate, Intrauterine, Birthweight, Growth curve, Rajavithi Hospital (RH)

Usually, intrauterine growth restriction (IUGR) is commonly classified when the estimated fetal weight is lower than tenth percentile for that gestational age (GA)[1]. Hence, the standard value of estimated fetal weight is very important to determine IUGR, because if false positive or false negative cases can be misinterpreted when the standard values are higher or lower than those in normal Thai populations. In Thailand, only two standard intrauterine growth curves were carried out many years ago, in Bangkok, central Thailand, (30 years ago)[2] and Chiang Mai, northern Thailand, (21 years ago)[3]. Therefore, the present study was designed to determine the distribution of Thai neonatal birthweights (BWs) classified by GA (24 to 42 weeks) and sex to create standard growth curves of Thai neonates delivered at Rajavithi Hospital (RH).

Material and Method

After approval by the RH Ethics Committee, a retrospective analysis was carried out by reviewing medical and labor records of parturients delivered at RH between January 1, 2010 and December 31, 2013. The inclusion criterias were singleton, pregnant women with viable fetus whose GA was between 24 and 42 weeks (168 to 294 days) was confirmed by any of the following:

a) Ultrasound scanning in first trimester, or

b) Regular menstruation and GA determined by last menstruation period (LMP) corresponding to those by ultrasound from 14 to 20 weeks GA

Those who had any medical, surgical, gynecological, obstetrical complications except preterm delivery or incomplete data cases were excluded. Dead fetus or congenital malformation was excluded. Demographic data such as mean maternal age, parity, route of delivery were collected. BWs were graphed as 5th, 10th, 50th, and 90th percentile and classified in each GA as male, female and both. All data were collected and analyzed. Percentiles were tabulated and plotted by sex for each GA. All analyses were performed using SPSS 17.0. The growth curves for 5th, 10th, 50th, and 90th percentiles of BW (y) on GA (x) was estimated using cubic regression equation function $(y = a + bx + cx^2 + dx^3)$[4].

Results

During the 4-year study period, 7,506 neonates, 3,973 male (52.9%) and 3,533 female (47.1%) were enrolled. Mean maternal age was 27.45 years. Most cases were employees (74.1%). Bachelor degree was the most common education level of the parturients

Correspondence to:

Kovavisarach E, Department of Obstetrics & Gynecology, Rajavithi Hospital, 2 Phayathai Road, Ratchathewee, Bangkok 10400, Thailand.
Phone & Fax: 0-2354-8084
E-mail: kekachai1@gmail.com

(47.3%). Spontaneous vaginal delivery was the most common route of delivery (61.8%). All mothers were Thai. Fig. 1 and 2 depicted intrauterine growth curve of male and female neonates, and all neonates respectively. The cubic regression equations for 50th percentile BW (y) on GA (x) were as follow:

Male: $y = 19,472 - 2,011.6x + 67.897x^2 - 0.6935x^3$ ($R^2 = 0.9975$)

Female: $y = 21,487 - 2,202.3x + 73.801x^2 - 0.7546x^3$ ($R^2 = 0.9981$)

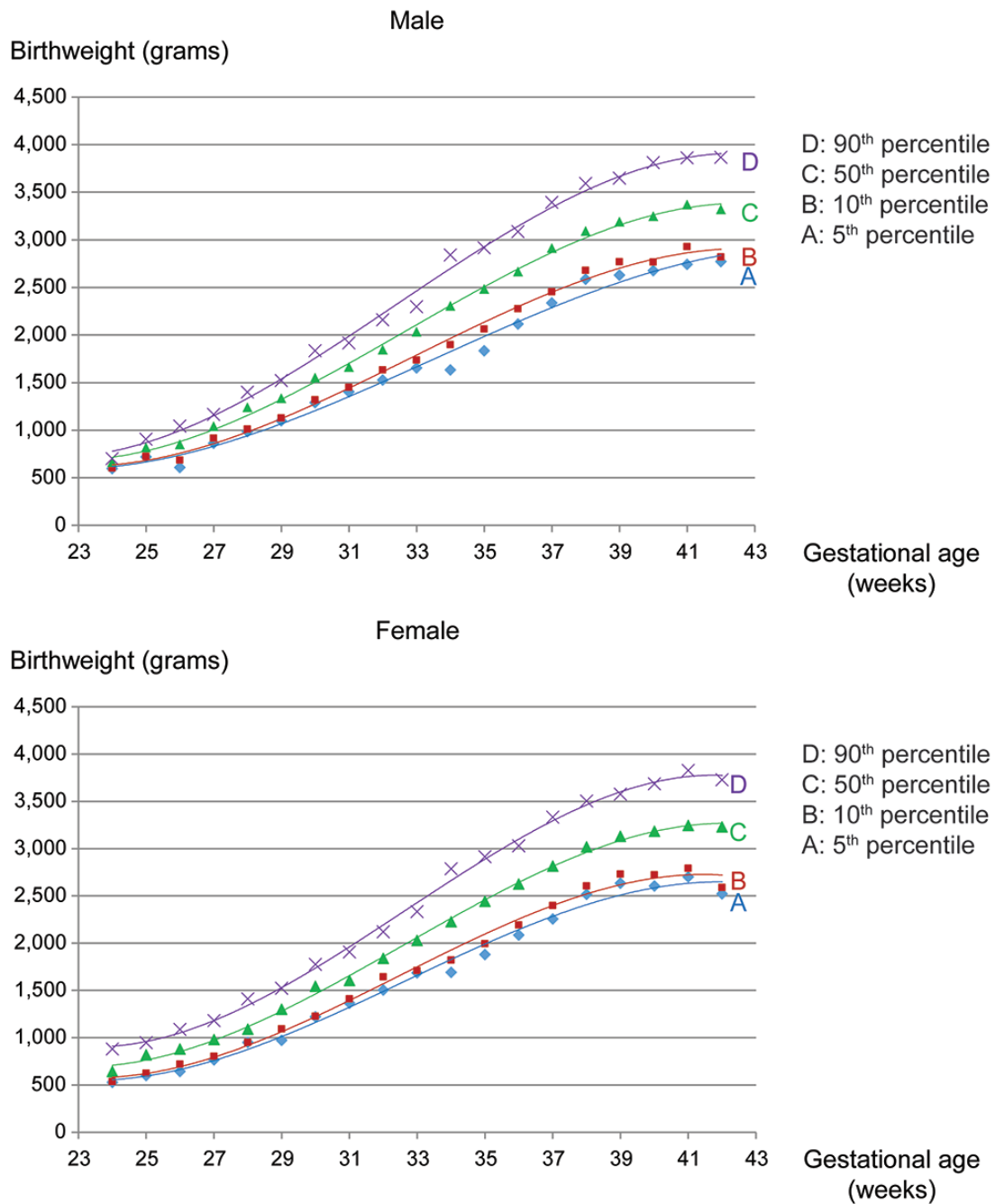All: $y = 20,704 - 2,130.2x + 71.629x^2 - 0.7324x^3$ ($R^2 = 0.9983$)

Fig. 1   Intrauterine growth curve of male and female neonates delivered at Rajavithi Hospital.

Smoothed percentiles and curve of BW (g) of both sexes for GA of neonates delivered at RH were shown in Table 1 and Fig. 3. Male BWs were higher than female BWs in all GA in every studied percentile. Almost every BW of overall neonates delivered at RH except the similar 90th percentile in RH and Chulalongkorn Hospital, were higher than both previous studies in Maharaj Nakorn Chiang Mai in 1991[3] and Chulalongkorn Hospital in 1984[2] (Table 2).

Discussion

Usually, intrauterine growth curves are created based on two styles, the first one is population-based parturients[5-7], and the other is
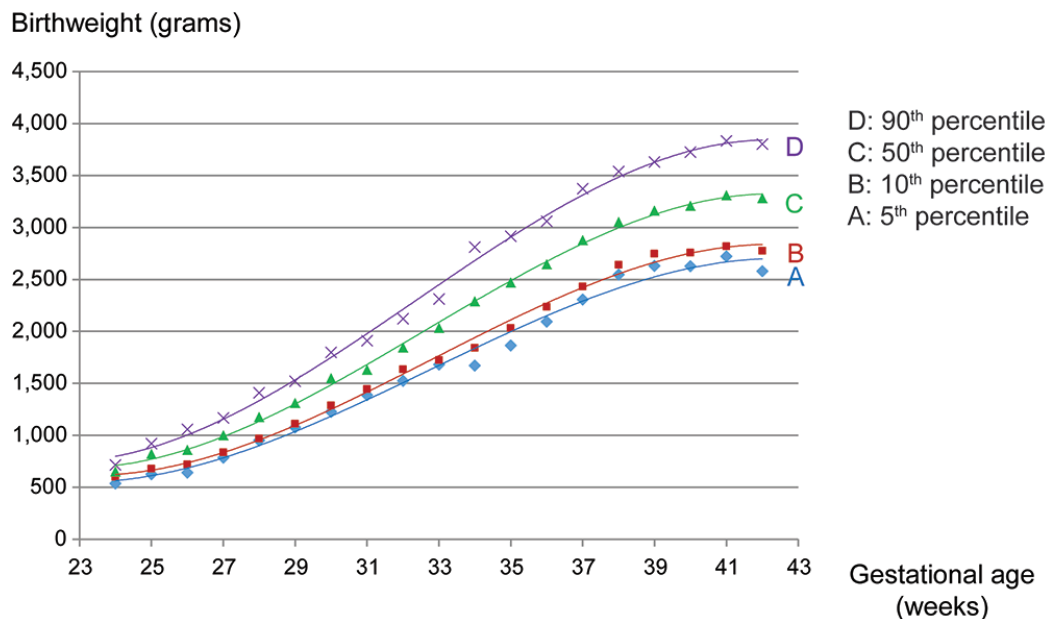
Birthweight (grams)

Fig. 2   Intrauterine growth curve of overall neonates delivered at Rajavithi Hospital.
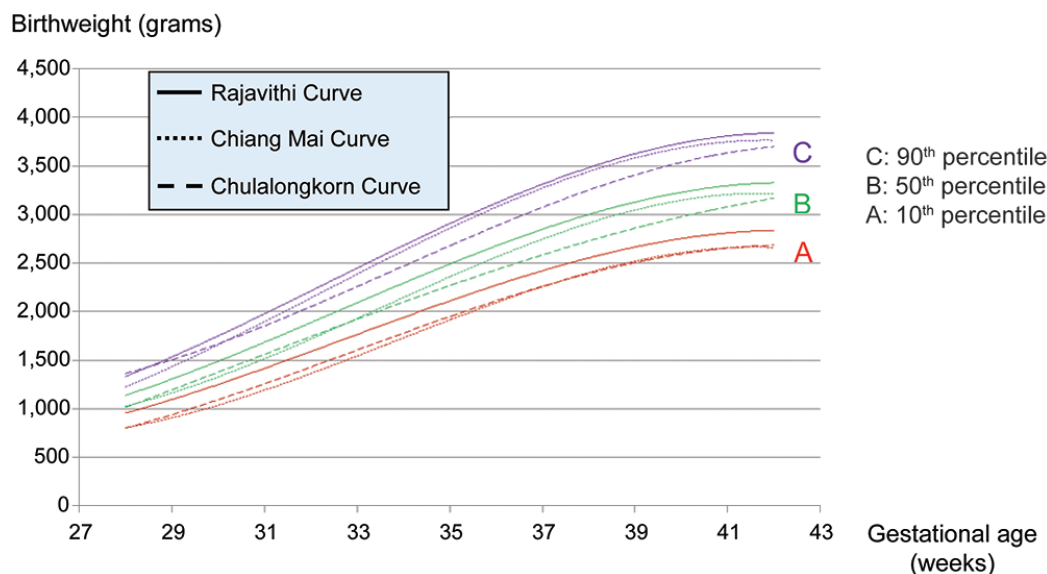
Birthweight (grams)

Fig. 3   Intrauterine growth curve of neonates delivered at Rajavithi Hospital, Chulalongkorn Hospital[2] and Maharaj Nakhon Chaing Mai[3].

Table 1. Smoothed percentiles of birthweight of male and female neonates delivered at Rajavithi Hospital

GA (weeks)	Percentiles							
	P 5		P 10		P 50		P 90	
	Male	Female	Male	Female	Male	Female	Male	Female
24	618	558	637	582	715	710	780	909
25	667	597	683	621	782	765	871	958
26	740	666	759	693	880	854	998	1,050
27	833	761	859	793	1,006	973	1,154	1,179
28	944	879	982	918	1,155	1,118	1,337	1,341
29	1,069	1,015	1,122	1,062	1,323	1,283	1,540	1,528
30	1,207	1,165	1,277	1,222	1,507	1,465	1,759	1,736
31	1,355	1,326	1,443	1,393	1,701	1,658	1,990	1,959
32	1,510	1,493	1,615	1,570	1,903	1,859	2,227	2,191
33	1,668	1,663	1,790	1,749	2,107	2,062	2,466	2,427
34	1,828	1,831	1,965	1,925	2,309	2,264	2,701	2,660
35	1,987	1,994	2,136	2,095	2,506	2,459	2,930	2,886
36	2,143	2,148	2,292	2,253	2,693	2,644	3,145	3,098
37	2,291	2,288	2,449	2,396	2,866	2,813	3,343	3,291
38	2,430	2,412	2,585	2,518	3,021	2,962	3,519	3,459
39	2,558	2,514	2,702	2,615	3,153	3,087	3,668	3,597
40	2,670	2,590	2,796	2,684	3,259	3,182	3,786	3,699
41	2,765	2,638	2,863	2,719	3,335	3,244	3,867	3,758
42	2,840	2,653	2,901	2,716	3,375	3,269	3,907	3,771

GA = gestational age

Table 2. Comparison all smoothed percentiles of birthweight of neonates for gestational age at Rajavithi Hospital, Chulalongkorn Hospital[2] and Maharaj Nakorn Chiang Mai Hospital[3]

GA (weeks)	Percentiles									
	Rajavithi Hospital (the present study) (2014)				Maharaj Nakhon Chiang Mai Hospital (1991)			Chulalongkorn Hospital (1984)		
	P 5	P 10	P 50	P 90	P 10	P 50	P 90	P 10	P 50	P 90
24	565	623	713	799	-	-	-	-	-	-
25	612	664	773	884	-	-	-	-	-	-
26	686	736	867	1,004	-	-	-	-	-	-
27	784	834	990	1,156	-	-	-	-	-	-
28	902	955	1,138	1,334	780	1,000	1,204	776	1,012	1,334
29	1,037	1,095	1,306	1,534	894	1,160	1,450	955	1,180	1,489
30	1,184	1,250	1,489	1,750	1,115	1,390	1,702	1,116	1,353	1,661
31	1,342	1,416	1,684	1,978	1,202	1,530	1,898	1,264	1,586	1,947
32	1,505	1,589	1,886	2,212	1,350	1,720	2,117	1,430	1,769	2,113
33	1,671	1,765	2,091	2,449	1,510	1,900	2,310	1,594	1,980	2,290
34	1,836	1,940	2,294	2,682	1,703	2,108	2,630	1,788	2,128	2,412
35	1,997	2,111	2,491	2,906	1,910	2,346	2,896	1,948	2,259	2,596
36	2,149	2,272	2,677	3,118	2,150	2,550	3,105	2,095	2,337	2,803
37	2,290	2,421	2,848	3,312	2,195	2,800	3,306	2,232	2,487	3,020
38	2,416	2,554	3,000	3,483	2,420	2,910	3,450	2,372	2,697	3,293
39	2,523	2,665	3,129	3,626	2,550	3,050	3,551	2,530	2,937	3,504
40	2,607	2,752	3,228	3,736	2,612	3,150	3,650	2,637	3,087	3,627
41	2,666	2,811	3,296	3,809	2,650	3,201	3,749	2,675	3,115	3,605
42	2,696	2,837	3,327	3,839	2,650	3,210	3,785	2,646	3,084	3,645

hospital-based parturients[2,3,8]. In developed countries such as the USA[7], Canada[10], and Australia[6], the birth registrations are quite accurately recorded. On the contrary, in developing countries such as Thailand, birth registrations are commonly inaccurately recorded because of late ANC and uncertain LMP. Consequently, the RH-based style was performed in the present study. Many factors affect the normal intrauterine growth curves in different countries such as ethnic, nationality, habitat (attitude) and culture[9,10].

Nowadays, normal and abnormal intrauterine growth is generally based on standards for BW, the endpoint of the growth, because the expected or potential size in each fetus could not be actually predicted. Thus, only physical parameters such as the 10th percentile was used to define the IUGR fetus[1]. The neonatal BW increased in order from Chulalongkorn Hospital in 1984[2], Maharaj Nakorn Chiang Mai in 1991[3] and RH, the present study in 2013. The influence of increasing westernized lifestyles such as diet, comfortable housing, decreasing the daily activity, and increased obesity have been suggested as one of the reasons to explain these phenomena. It is interestingly, the characteristics of all curves in different places and times are quite similar in the 10th, 50th, and 90th percentile.

When compared with similar hospital-based papers[2,3], the strength of the present study included having the largest sample size, and enrolled only healthy mothers without any complications except preterm delivery, recorded of BW between 24 to 42 weeks GA. Finally, the present study included 24 to 27 weeks GA while the other Thai studies did not[2,3].

One limitation of the present study was retrospective design. As a result, assessment of GA of the babies could not be conducted in every case because assessing the exact GA of every neonate was not the routine work in RH. However, GA was confirmed by early ANC before 20 weeks GA, with any of the following: a) 1st trimester ultrasound, or b) regular menstruation, and GA determined by LMP corresponding to those by ultrasound during 14 to 20 weeks GA.

In conclusion, male BW was higher than female BW in all GA. Mean BW at 40 weeks GA in male, female and both were 3,153, 3,087, and 3,129 g, respectively.

What is already known on this topic?

In Thailand, there were only two standard intrauterine growth curves reported many years ago

in Bangkok, central Thailand, (30 years ago) and Chiang Mai, northern Thailand, (21 years ago), so they were out of date.

What this study adds?

The neonatal BW has been gradually increased, from Chulalongkorn Hospital in 1984, Maharaj Nakhon Chiang Mai in 1991 and RH, to the present study in 2013. The influence of westernized lifestyles such as diet, comfortable housing, decreasing the daily activity, and increasing obesity been suggested as one of the reasons to explain these phenomena. However, the characteristics of all curves in different places and times were quite similar in the 10th, 50th, and 90th percentile. The present study created a standard intrauterine growth curve of Thai neonates in this decade.

Potential conflicts of interests
None.

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กราฟมาตรฐานการเจริญเติบโตของทารกในครรภ์ที่คลอดที่โรงพยาบาลราชวิถี

เพียว บริสุทธิ์, เอกชัย โควาวิสารัช

วัตถุประสงค์: ศึกษาลักษณะการกระจายตัวของน้ำหนักแรกคลอดของทารกไทยแบ่งตามอายุครรภ์และเพศ เพื่อนำมาสร้างกราฟมาตรฐานการเจริญเติบโตของทารกในครรภ์

วัสดุและวิธีการ: ทำการศึกษาแบบย้อนหลังโดยเก็บข้อมูลน้ำหนักทารกแรกคลอดที่คลอดจากมารดาครรภ์เดี่ยวที่ตั้งครรภ์ปกติ และทราบอายุครรภ์แน่นอน ซึ่งมีอายุครรภ์ขณะคลอดอยู่ระหว่าง 28 ถึง 42 สัปดาห์ (168 ถึง 294 วัน) และนำข้อมูลดังกล่าวมาเขียนเป็นกราฟน้ำหนักแรกคลอดทารกที่เปอร์เซ็นต์ไทล์ที่ 5, 10, 50 และ 90 แบ่งตามเพศ และอายุครรภ์ของทารกแรกคลอด

ผลการศึกษา: ทารกไทยแรกคลอดทั้งหมด 7,506 คน แบ่งเป็นเพศชาย 3,973 คน และเพศหญิง 3,533 คน ทารกเพศชายมีน้ำหนักในทุกเปอร์เซ็นไทล์มากกว่าทารกเพศหญิงในอายุครรภ์เดียวกัน โดยกราฟมาตรฐานการเจริญเติบโตของทารกในครรภ์ที่เปอร์เซ็นไทล์ที่ 5, 10, 50 และ 90 ในเพศชายมากกว่าเพศหญิงแต่มีลักษณะของกราฟคล้ายคลึงกัน

สรุป: น้ำหนักแรกคลอดของทารกเพศชายมีค่ามากกว่าทารกเพศหญิงในแต่ละอายุครรภ์ แต่มีรูปแบบการเจริญเติบโตคล้ายคลึงกัน